

PHENIX
Muon Tracker
Front-End Electronics

**Summary of
Progress, Changes
Cost & Schedule**

Muon Arms VTC

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April 29, 1998

Outline

- **Reminder of Constraints**
- **Scope**
- **Progress since Sep97 BNL Muons Meeting**
- **Changes**
- **Schedule & Cost**

Constraints on MuTr FEE

- **Nothing between Stations 1 & 2**
- **Stations-2&3 electronics inside magnet**
 - minimal-to-no access for very long periods
 - low-noise electronics in a magnetic field
 - low-noise electronics inside a dirty “oven”
 - » **cooling in a hot/humid/stagnant environment**
 - fluid-based cooling
 - dried atmosphere with good thermal conduction
 - » **enclosures for environmental isolation**
- **Nothing in acceptance downstream of Sta-1**
- **Clear lines of sight for alignment monitoring**
- **Limited space in both r and z at Station-1**
 - Also must leave space for BB-counters' cabling
- **Minimal cathode analogue-cable lengths**

Constraints on MuTr FEE **(continued)**

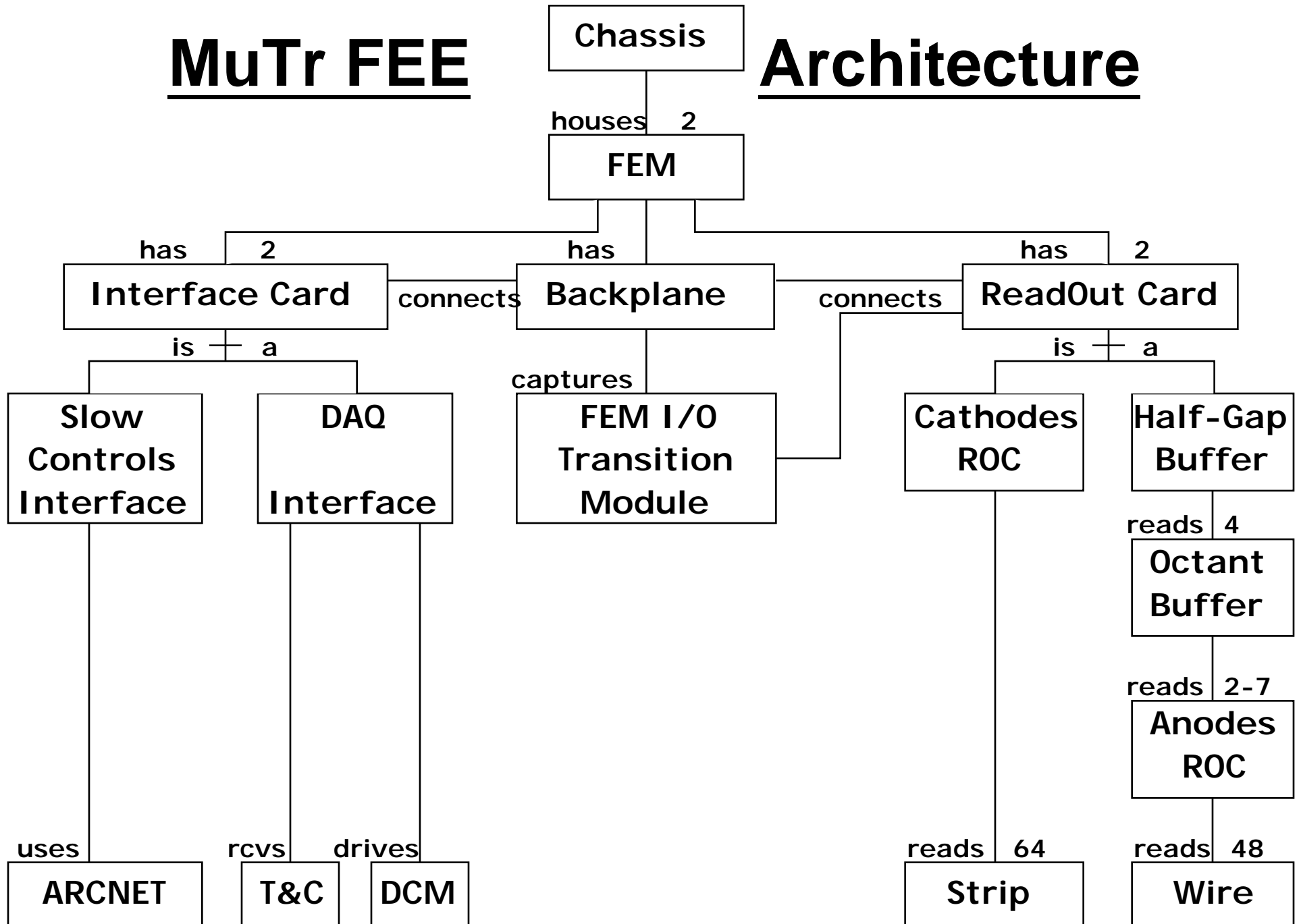
- **Limited magnet “penetrations” available**
- **Top 5 lampshade panels are removable**
 - Cannot attach to/mount anything from them
 - Must try to avoid having anything delicate near them
- **Must not distort or load detector structures**
 - Separate FEE mounting structures
- **Must avoid noise sources safely**
 - Electrical “isolation” wrt detector mounts & magnets

Summary of MuTr Channel Counts

Station	phi-cm/oct	strips/oct	Cathodes	r-cm/oct	wires/oct	Anodes
1N	104	96	4608	100	96	2304
2N	U:208 D:214	192	9216	U:187 D:194	192	4608
3N	354	320	15360	320	320	7680
Subtot N	Cathodes		29184	Anodes		14592
1S	104	96	768	100	96	2304
2S	U:178 D:186	160	7680	U:161 D:168	160	3840
3S	268	256	12288	241	240	5760
Subtot S	Cathodes		24576	Anodes		11904
Totals	Cathodes		53760	Anodes		26496

MuTr FEE

Architecture



Cathode FEE Counts

Station	Strips/Oct/Pln	Cathodes/Oct	ROCs/Oct	ROCs/Sta	FEMs/Sta	Chassis/Sta
1N	96	576	9	72	40	20 Full + 0 Half
2N	192	1152	18	144	72	32 Full + 8 Half
3N	320	1920	30	240	120	56 Full + 8 Half
Subtot N			57	456	232	108 Full + 16 Half
1S	96	576	9	72	40	20 Full + 0 Half
2S	160	960	15	120	64	32 Full + 0 Half
3S	256	1536	24	192	96	48 Full + 0 Half
Subtot S			48	384	200	100 Full + 0 Half
Totals			105	840	432	208 Full + 32 Half

Progress since Sep97

BNL Muon Arms Meeting

- **Conceptual Design Review (31Oct–01Nov97)**
- **Prototyped Cathodes PreAmp (CPA) ASIC**
 - Test Stand development completed
 - » Both bench-top & on-detector-prototype tests (integrates with LANL DDL DAQ system)
 - CPA prototype chips now under test
 - 2 minor design mods
 - CPA Production ASAP after 10/1/98
- **Detailed Spec'n for Detector-FEE Circuit**
 - Enabled other detailed designs to proceed:
 - » “Grounding” Scheme
 - » LVDC Power layout
 - » HVDC distribution
 - » Detector-FEE Cabling

Progress since Sep97 (cont)

- **Explored Alternate CathodesROC Concept**
 - Based on Commercial FADCs & Discrete-ICs
 - » Alternate to AMUADC32
 - *Dropped, based on relative costs*
- **Detailed full Anodes Readout Subsystem**
 - Commensurate w Cathodes subsystem detailing
 - Based on all-COTs Discrete-ICs
 - *Further development deferred (see below)*
- **Detailed Timing System layout**
- **Detailed ARCNet layout**
- **Detailed Ancillary Controls & Monitoring Reqs**
- **Completed Detector-Anodes PCB designs**
 - Detector-Cathodes PCB designs underway
 - Passed to Detectors Team

Progress since Sep97 (cont)

- **Detailed FEM Backplane design**
 - Thru preliminary PCB layout and routing
- **Started detailing CFTM design**
- **Cont'd developing Slow Controls concept**
 - Adapting Drift Chambers SC approaches
- **Continued detailing Mechanics designs**
 - Extended to exterior platforms, racks, etc.
- **Continued detailing Cooling Sys design**
- **Continued detailing FEM Chassis design**
- **Started detailing Station-1 FEE layout**
 - Very Tight Integration with Sta1 Dets, BB, CM, ...
- **Started detailing cabling & services plants**

Progress since Sep97 (cont)

- **Began studying an alternate scheme for Anodes readout**
 - Based on Muld-like system external readout crates
 - ★ Cabling vs Space implications (minor) magnet mods
- **Started developing FEE installation scenarios**
 - Requires tight integration with detector installation
 - Requires detailed integration with other PEH plans
- **Formulated detailed Schedule projection(s)**
 - Detailed test & integration sequencing for prototypes
 - Production Assembly, Test & Installation plans
- **Done complete bottoms-up Cost estimate**

Changes

- **Instrument only 2/3 Sta3 gaps**
 - Overall Cost (Saves ~ \$475k in FEE Costs alone)
- **Alternate Anodes Readout**
 - Overall Cost & Manpower
 - Defer further development of original, distributed scheme
 - Study option based on Muld-like scheme
 - » Only Amp+Tx inside magnets, driving analogue to Muld-like readout crates external to magnet
 - Bigger notches in removable lampshade panels
- **Delay further development of Anodes readout until Cathode readout completed**
 - Manpower & Funding Profile
- **Consolidate MuTrFEE Team**
 - Loss of ORNL manpower to CBMS (Dec97)
 - Competition for ORNL manpower with other PHENIX FEE

Everything except CPA @ LANL

Revised Cathode FEE Counts (for 2 of 3 gaps in Sta3's)

Station	Strips/Oct/Pln	Cathodes/Oct	ROCs/Oct	ROCs/Sta	FEMs/Sta	Chassis/Sta
1N	96	576	9	72	40	20 Full + 0 Half
2N	192	1152	18	144	72	32 Full + 8 Half
3N	320	1280	20	160	80	40 Full + 0 Half
Subtot N			47	376	192	92 Full + 8 Half
1S	96	576	9	72	40	20 Full + 0 Half
2S	160	960	15	120	64	32 Full + 0 Half
3S	256	1024	16	128	64	32 Full + 0 Half
Subtot S			40	320	168	84 Full + 0 Half
Totals			87	696	360	176 Full + 8 Half

Changes (cont)

- **All Chassis & Cooling Design “in-house”**
 - Cost
- **Delay almost all prototyping until 10/1/98**
 - Funding Profile
- **Delay CPA Prod’n until 10/1/98**
 - Funding Profile
- **Delay S-Arm Cathodes Prod’n until 4/1/99**
 - Funding Profile
- **Delay N-Arm Cathodes Prod’n until 10/1/99**
 - Funding Profile
- **Sequence Production & Installation as**

S-Arm Cathodes	N-Arm Cathodes
S-Arm Anodes	N-Arm Anodes

 - Funding Profile & Access to Assembly vs Collision halls,
Coupled to Detector Installation & Other PEH Activities

Schedule Summary

- ◆ **06/23/98 CPA Tests & Design Updates done**
- ◆ **All other designs now in progress, *except***
 - Slow Controls Interface (Starts 06/15/98, \$ & manpower)
[not in full swing until 10/01/98]
 - FEM Power Card (Starts 10/01/98, \$ & manpower)
- ◆ **10/01/98 Start CPA Production (\$\$\$)**
02/10/99 Production CPA chips available
- ★ **10/01/98 Most Prototype Fab Starts (\$\$\$)**
- ◆ **06/17/99 Cathodes Design Integ'n Tests Done**
Start fabricating production units for S-Arm Cathodes
» After 04/01/99 (JFY boundary)
- ◆ **09/16/99 FEM Assembly & Test Lines Ready**
★ Preparation overlapped with FEM board fab & stuff
- ◆ **08/05/99 S-Arm Detectors Installation Done**
FEE Infrastructure installation can begin !

Schedule Summary (cont)

◆ 11/10/99 Begin S-Arm Cathodes FEM Install'n

★ *FEM Assembly Lines Continue for N-Arm*

◆ 02/14/00 S-Arm Cathodes FEMs Installed

S-Arm Ready for Roll-In

◆ 12/21/00 Start N-Arm Cathodes FEM Install'n

– Available 03/13/00 BUT

» Collision Hall Closed until 05/26/00 for Run-1

» Then N-Arm Detectors must be installed

» Then FEE Infrastructure must go in

◆ 03/30/01 N-Arm Cathodes FEMs Installed

★ *Room for optimization in N-Arm Install'n ?*

★ *Don't want Run-2 start until (10/1/01 - 34ew) !*

Schedule Summary (cont)

- ◆ **05/15/00 Anodes Readout Design Resumes**
 - Engineers done supervising N-Arm Cathodes production
 - ◆ **12/04/00 – 04/03/01 Anodes Parts Production**
 - ◆ **07/05/01 S-Arm Anodes FEMs Installed**
 - ◆ **08/30/01 N-Arm Anodes FEMs Installed**
- ★ ***But no accounting yet for Assembly and Collision Halls accessibility after 05/26/00 !***

Cost Summary

WBS	Description	Amounts in FY 98 k\$					
		Total	M&S	EDIA	Labor	Cont(%)	Cont (k\$)
Total Project							
	Total Project Cost	5,648.5	3,096.9	2,043.3	508.3	19%	1,046.6
	MuTrFEE preliminary Conceptual Design	276.3	0.0	276.3	0.0	0%	0.0
	MuTrFEE Conceptual Design	217.0	0.0	217.0	0.0	0%	0.0
5.3.13	MuTrFEE Construction	5,155.2	3,096.9	1,550.0	508.3	20%	1,046.6
5.3.13.1	Anodes-specific Components	1,247.1	1,094.1	132.1	20.9	20%	249.4
5.3.13.2	Anodes FEE Assembly, Test, Installation	179.7	26.0	38.3	115.4	20%	35.9
5.3.13.3	Cathodes-specific Components	1,043.7	693.2	332.8	17.8	23%	239.7
5.3.13.4	Front End Module Interfaces	866.4	653.3	200.8	12.3	20%	171.2
5.3.13.5	FEM Chassis	106.3	61.2	33.9	11.2	20%	21.3
5.3.13.6	Cathodes FEMs Assembly, Test, Installation	268.0	74.0	82.9	231.2	20%	77.6
5.3.13.7	Cooling System	150.2	107.4	38.1	4.7	20%	30.0
5.3.13.8	In-Magnet Mechanics	362.4	236.7	93.6	32.1	20%	72.5
5.3.13.9	External Mechanics	81.9	34.2	38.1	9.6	20%	16.4
5.3.13.10	Detector-Fee Circuit, Power & Grounding	91.1	32.0	59.1	0.0	20%	18.2
5.3.13.11	Online Interfaces	96.3	43.0	0.0	53.3	6%	5.9
5.3.13.12	Ancillary Systems	41.7	41.7	0.0	0.0	20%	8.3
5.3.13.13	Detector-FEE Integration	0.0	0.0	0.0	0.0	0%	0.0
5.3.13.14	Systems Engineering	500.3	0.0	500.3	0.0	20%	100.1
5.3.13.15	Project Management	0.0	0.0	0.0	0.0	20%	0.0